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Grains of Description in Biological and Cultural Transmission

Pierrick Bourrat | ORCID: 0000-0002-4465-6015
Senior Lecturer, Philosophy Department, Macquarie University,
Sydney, NSW, Australia
p.bourrat@gmail.com

Mathieu Charbonneau
Assistant Professor, Faculté de Gouvernance, Sciences Économiques
et Sociales, Université Mohammed VI Polytechnique, Rabat, Morocco
mathieu.charbonneau@um6p.ma

Abstract

The question of whether cultural transmission is faithful has attracted significant debate over the last 30 years. The degree of fidelity with which an object is transmitted depends on 1) the features chosen to be relevant, and 2) the quantity of details given about those features. Once these choices have been made, an object is described at a particular grain. In the absence of conventions between different researchers and across different fields about which grain to use, transmission fidelity cannot be evaluated because it is relative to the choice of grain. In biology, because a genotype-to-phenotype mapping exists and transmission occurs from genotype to genotype, a privileged grain of description exists that circumvents this 'grain problem.' In contrast, in cultural evolution, the genotype–phenotype distinction cannot be drawn, rendering claims about fidelity dependent upon researchers' choices. Thus, due to a lack of unified conventions, claims about fidelity transmission are difficult to evaluate.

Keywords

cultural transmission – fidelity – grains of description – cultural evolution

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1 Introduction

You are observing children playing a game of telephone. In this game, children form a transmission chain. The child at the beginning of the chain chooses a message, which they whisper to the second child. The second child then whispers what they heard to the third child, and so on, until the end of the chain. The message reaching the last child is often quite different from the original message. Now, suppose that you are asked to assess the extent to which the original and final messages are similar. However, the problem is that you are not familiar with the language used by the children to communicate. How shall you proceed?

To illustrate the difficulty of this task, let us say that the children speak Mandarin, a *tonal* language – that is, where a difference in pitch can convey semantic information (Yip 2002). In contrast, in English, using different tones to pronounce a syllable is used to mark emphasis only; it does not affect the meaning of a word. Suppose that the original message of the first child in the chain is very simple: 'mǎ,' which means 'horse.' As the message is transmitted along the chain, at some point, a child misinterprets it and instead understands: 'mā,' which means 'mother.' This child then passes the transformed message down the chain. Thus, as a naive English speaker, who knows nothing about Mandarin, you are asked to compare 'mǎ' with 'mā' and decide how similar (or different) they are. Extrapolating from English, you would not consider the difference in tone to be a crucial difference and would conclude that the message was transmitted accurately throughout the chain. However, for a Mandarin speaker, the meaning of the message has changed dramatically.

The problem illustrated by this example is a general one. As such, it applies not only to linguistic communication but also to processes of transmission in general; therefore, it has been noted in different domains by various authors, such as for genetic transmission (e.g., Bourrat 2019b) and cultural transmission (e.g., Acerbi and Mesoudi 2015; Charbonneau 2020; Charbonneau and Bourrat 2021). Stated simply, the problem is that an event of communication, in and of itself, does not tell us what aspect(s) of the information sent from the emitter is relevant for the receiver(s) (Sperber and Wilson 1995). Without some *a priori* knowledge of the context in which this message is sent, it is nearly impossible to know which aspects are relevant for assessing the similarity between what the emitter produced and what the receiver understood.

As we show in this paper, this situation arises in both biology and culture; however, the implications of this problem for biology and cultural evolution are different. The problem is solved in biology by the existence of a genotype–phenotype mapping. Conversely, in the case of culture, because there is no such clear distinction, the situation is different. This difference emerges as crucial for cultural evolution researchers in relation to producing a common standard to assess the fidelity of cultural transmission.

2 Transmission in the Biological Domain

To assess the fidelity of any transmission event, features of what is transmitted will be deemed either relevant or irrelevant. Consider DNA replication. DNA is a molecule composed of two strands, each serving as a template for producing a complementary strand. To form a complementary strand, the enzyme DNA polymerase recruits nucleotides composed of one of four nitrogenous bases (A, C, T, and G): the basic units of the genetic code. Once a complementary strand has been formed fully from each strand of the DNA molecule, the process of replication is complete (for further details on the process of DNA replication, see Watson et al. 2013).

In molecular biology, DNA is taken to be replicated faithfully to the extent that the offspring DNA molecules share the sequence of nitrogenous bases of the parental molecule (see Watson et al. 2013, chap. 9). However, in principle, this is not the only aspect on which researchers could focus. For instance, one could examine one particular atom of carbon in each nucleotide of an offspring DNA molecule and determine whether the corresponding carbon atom in the parental DNA is of the same isotope (^{12}C, ^{13}C, and ^{14}C). Using this method, one could assess whether a DNA molecule is replicated faithfully with respect to its sequence of carbon isotopes. Crucially, note that a DNA molecule might be replicated perfectly in terms of nitrogenous bases but imperfectly in terms of carbon isotopes (or vice versa).

Today, no one would determine whether a DNA molecule has been replicated faithfully by examining its sequence of carbon isotopes. This is so because there is no reason to believe that a causal relationship exists between the variation in carbon isotopes of the DNA molecule and the phenotype that an organism develops. Conversely, we know that particular sequences of nitrogenous bases in DNA explain the presence or absence of certain phenotypes.[1]

1 In using 'causal relationship,' we have a difference-making account of causation in mind. Following one version of this account, a variable *C* with two possible states, 'c_1' and 'c_2,' is a cause of another variable *E* with two states, 'e_1' and 'e_2', if and only if intervening on one value of *C* and changing its value (from c_1 to c_2 or c_2 to c_1) would lead to a change in the value of *E* (from e_1 to e_2 or e_2 to e_1). For different more or less formalized versions of this account,

When studying an organism, a geneticist[2] wants to know whether a particular observable feature of the organism (a phenotype) is passed to successive generations. Generally, phenotypes are passed *indirectly* rather than directly from parents to offspring – that is, a parental phenotype does not participate in the production of the offspring phenotype.[3] Rather, both the parental phenotype and the offspring phenotype are caused by the organisms' genotypes: the sequence of nitrogenous bases in each organism's DNA. Assuming an identical developmental environment for each organism, to their particular DNA sequences of nitrogenous bases (DNA_{NB}) corresponds a specific phenotype.[4] In contrast, because there is no known causal link between a DNA sequence of carbon isotopes (DNA_{CI}) and any other feature of an organism (i.e., any phenotype), DNA_{CI} fails to constitute (or be part of) the genotype of an organism. Even if, at every generation, DNA_{CI} was replicated faithfully, this would not be a genetically relevant fact in the absence of a causal link between DNA_{CI} and a phenotype.[5]

When the features focused on are either part of the genotype or phenotype of an individual, one can evaluate the degree of fidelity between successive events of transmission at a grain of description. This is done by comparing the parental feature (genotype or phenotype) with the corresponding offspring feature. When the parent's genotype or phenotype is correlated with that of the offspring, the transmission has some fidelity.

Any description of an entity's transmission event, whether direct or indirect, defines a *grain of description* at which this entity and its transmission are characterized. Pragmatically, we define a grain of description as both (1) the features chosen by an observer to describe an entity, and (2) the resolution

including in a biological context, see Woodward (2003; 2010), Pearl (2009), Griffiths et al. (2015), and Bourrat (2019a; 2021).

2 By 'geneticist' and 'genetics,' we refer to the molecular concept of the gene, which is but one of many concepts of the gene (Griffiths and Stotz 2013; Griffiths and Neumann-Held 1999; Lu and Bourrat 2018).

3 We will see below that the situation is more complex in reality; however, this view can be regarded as a received view.

4 Note that, typically, this phenotype will not be determined perfectly. It will vary with environmental change, in addition to the background of developmental resources (e.g., different species, different age-class). However, the point is that, with relevant background information, one could predict with some probability higher than chance a phenotype from a DNA_{NB} sequence.

5 To be more precise, the only phenotype whose transmission would be ensured by a sequence of carbon isotopes in DNA is the sequence of isotopes itself, in which case the distinction between genotype and phenotype breaks down.

involved in the description of these features.[6] For instance, describing an object as 'red,' 'spiky,' or 'red and spiky' represents three grains of description in terms of those features focused on. Describing it as 'scarlet' or 'magenta' rather than 'red,' or 'red' or 'blue' rather than 'colored,' represents two other grains of description, this time in terms of resolution. To make the distinction more relevant to biology, we might describe an individual as having 'almond shaped,' 'blue' or 'almond shaped and blue' eyes. For each phenotype, we might provide a coarser-grained (e.g., 'light' eyes) or a finer-grained (e.g., 'pure light blue' eyes) description.

In principle, there is more than one grain of description in terms of the features by which the fidelity of transmission between parent and offspring can be assessed. Consistent with what we have said about DNA characterized either as DNA_{CI} or as DNA_{NB}, transmission from parent to offspring can vary widely depending on which features of an organism one focuses on. For instance, had it been the case that other features of DNA beyond DNA_{NB} were linked causally to a biologically relevant phenotype, there would be two legitimate grains of descriptions at which to assess the degree of transmission fidelity in biology. There are known examples where DNA_{NB} is not the relevant feature of organisms for explaining the phenotypic similarity between parent and offspring. Some epigenetic (non-DNA_{NB}) factors can influence a phenotype causally and be transmitted with some fidelity across generations (Jablonka and Lamb 2014).

Focusing now on the resolution at which a feature is described, if we take a DNA molecule, one might describe it using a *fine* grain by giving its exact nitrogenous base sequence, or *more coarsely* by listing, for instance, the genes present on it. Both descriptions might produce different measures of fidelity. This is because multiple sequences of nitrogenous bases lead, in some cases, to the same phenotype and can, thus, be regarded as a single gene.[7] Therefore, two very different DNA_{NB} might be very similar if described in terms of the genes they contain. Note that fine-grained descriptions refer to more-determinate properties than coarse-grained descriptions, the latter of which refer to more-determinable properties (for details regarding the distinction between determinate and determinable properties, see Wilson 2017; see also Bourrat 2014 for a use of this distinction in the context of heredity).

6 We borrow the term 'resolution' in this context from Godfrey-Smith (2012). There exist interesting metaphysical issues relating to grains of description; however, we will steer clear of these.

7 The reason different nitrogenous base sequences can be considered as the same gene is that the genetic code is, to some extent, degenerate (Watson et al. 2013, 573–81).

While differences in choices of grains of description can lead to different values of transmission fidelity – both for differences in features and in the resolution used to describe these features – there is a crucial difference between the two. Whereas measuring different features may produce independent measures of transmission fidelity, different measures of transmission fidelity of a single feature at different resolutions will not be independent. This is because coarser grains of description always supervene on finer ones. Following a classical definition of supervenience (McLaughlin and Bennett 2018), substituting a gene for another – at a coarse grain of description – would necessarily lead to some changes in the sequence of nitrogenous bases – at the fine grain of description. However, as mentioned above, changing the sequence of nitrogenous bases would not necessarily change the sequence of genes. One consequence of this asymmetric relationship is that one could recover the degree of transmission fidelity at the coarser grain of description from the finer grain by lumping different values of the sequence of nitrogenous bases into a single value corresponding to the coarse grain of description.[8] However, this would result in leaving out some information about the finer-grained description. In turn, this loss in information shows that the inverse process is impossible – it is not possible to recover a fine-grained description from a coarser one if we do not have more information than the one provided by the coarse-grained description.

The above reasoning leads to two conclusions. First, in biology, there is at least one feature of an organism that causes its phenotype. This aspect of organisms is their DNA_{NB}. However, DNA_{NB} is not the only feature influencing phenotypes across generations. Epigenetic factors have been shown to have some significant evolutionary effects (Jablonka and Lamb 2014). That being said, in most of these cases, a molecular mechanism has been proposed (for extensive reviews of known cases in different taxa and the mechanisms involved, see Jablonka and Raz 2009; Jablonka and Lamb 2020). Many of these mechanisms provide some stability of the phenotype across generations. Thus, the poster child picture presented here might be challenged; however, these mechanisms would only lead to a severalfold increase in an organism's number of 'genotypes' or biological channels of transmission.

8 Despite an atom of carbon being smaller and a component of a nitrogenous bases, the isotopy of a carbon atom is an aspect of a nitrogenous base that has no causal influence on the type of nitrogenous base relevant for phenotypes (A, T, C, or G). For that reason, it does not represent a finer grain of description for the type of nitrogenous bases in the sense that a DNA_{NB} represents one for a sequence of genes.

In the next section, we discuss cultural transmission and assess how it compares with transmission in the biological domain. We argue that the conclusions reached about biological transmission cannot be reached for cultural transmission and that this has several implications when studying the faithfulness of cultural transmission.

3 The Challenge of Setting the Grain of Description in Cultural Transmission

3.1 *Phenotype and Genotype in the Cultural Domain*

Central to the field of cultural evolution is the process of cultural transmission (Henrich 2016; Mesoudi 2011; Morin 2016; Richerson and Boyd 2005; Lewens 2015; Sperber 1996). In an episode of cultural transmission, an individual first produces a public display from the mental representation they possess. For instance, thinking about the telephone game, the first child produces an utterance that conveys the message they have in mind. Then, that public display is used by a learner to acquire some mental representation of their own (i.e., hearing the utterance, the learner infers what the message is) (Richerson and Boyd 2005; Sperber 2006). Some cultural evolutionists conceive of mental representations serving as an analog to a genotype, and corresponding public displays as an analog to a phenotype (e.g., Boyd and Richerson 1985, 36; Mesoudi 2011, 44). At first, this seems to make sense because individuals use their knowledge to produce some public display. However, a crucial difference between biological and cultural transmission renders this analogy problematic (Charbonneau 2015).

As discussed in the previous section, in biology, the genotype of an organism causally influences the production of a phenotype; however, the phenotype does not participate in the production of the genotype – or, at least, this simplifying assumption is pragmatically useful. It is this causal asymmetry that makes the genotype/phenotype distinction meaningful (see Figure 1). In contrast, when an item in the cultural domain is transmitted, this typically occurs through an alternation of public displays and mental representations, but never by a lineage of mental representations only (see Figure 2). Therefore, there is no causal asymmetry as in the case of genetic transmission; further, both mental representations and public displays can serve the role of genotype and phenotype since they participate in the production of one another: they are causally promiscuous (Sperber and Claidière 2006; Sperber and Hirschfeld 2007). In other words, this situation would be equivalent to a biological situation where the genotype at generation *n* produces

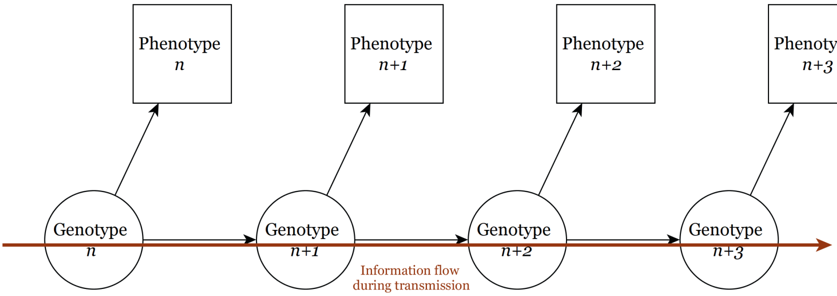

FIGURE 1 Transmission in the biological domain. A genotype contributes directly to the production of a phenotype at the same generation and the production of a genotype at the next generation. Information flows across generations from genotype to genotype. The asymmetry between genotype and phenotype permits distinguishing a genotype from a phenotype.

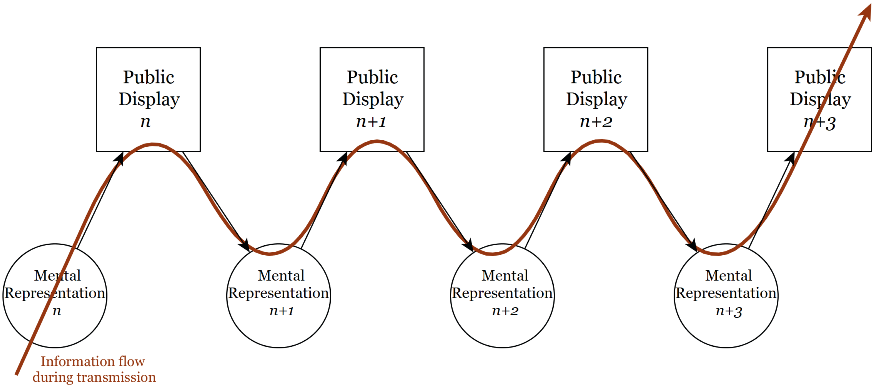

FIGURE 2 Transmission in the cultural domain. A mental representation contributes directly to the production of a public display at the same generation but not to the production of a mental representation at the next generation. Moreover, a public display contributes directly to the production of a mental representation at the next generation. Information flows from mental representation to public display, and back to mental representation, and so on. Any part of the information flow causal chain could be regarded as a cultural equivalent of the genotype or the phenotype, making the genotype/phenotype distinction in cultural transmission arbitrary and unhelpful.

the phenotype at generation n, and the phenotype at generation n serves as a template for the genotype at the generation $n + 1$. Consequently, the distinction between genotype and phenotype in the cultural domain is not useful. This, in itself, does not render any discussion of genotype/phenotype strictly speaking false; however, it makes such a distinction arbitrary and prone to confusion. For instance, it might elicit the false belief that biological and cultural transmission are analogous when they are, in fact, fundamentally different.[9]

The fact that there is no clear demarcation between genotype and phenotype has a significant implication when assessing the extent to which cultural transmission is faithful. Recall that what makes DNA_{NB} *the* feature to focus on when measuring the fidelity transmission is the *causal role* it serves in producing a phenotype distinct from itself. This causal role sets a grain at which to assess the extent to which phenotypes are transmitted across generations. If there is no relevant distinction between genotype and phenotype to draw in the cultural domain, unless there is a particular reason to focus on some aspects of cultural items rather than others, there is potentially an infinity of grains of description at which to measure the fidelity of transmission. This is so because there is an infinity of ways to describe an object. For example, consider an artifact such as a boomerang. One could focus on many features when describing this object (e.g., its material, shape, length, aerodynamic properties), each of which can be described with more or less resolution. If there are no general rules regarding which features of a cultural item are relevant for assessing what has been transmitted, there is no general way to determine to what degree the transmission has been successful. Indeed, unless the learner uses specific rules for transmitting and reconstructing any and all types of cultural items, potentially *any* feature of a cultural item is a candidate for measuring fidelity. See Charbonneau (2020) for a related argument.

One might assume there to be some general rules for determining which features are relevant for cultural transmission by finding a nearly universal code for the cultural domain, as occurred in molecular biology with the discovery of a quasi-universal genetic code.[10] Mesoudi (2011) pursues this line of reasoning and calls for a 'neuromemetics' to find this code. However, others have expressed skepticism regarding whether this is a serious possibility (Richerson and Boyd 2005). Due to the lack of a genuine distinction between cultural 'genotype' and 'phenotype,' the prospects are quite bleak.

9 Of course, there are some exceptions to this picture – for instance, when the information is codified before being transmitted, such as the lines of code copied on the hard drive of two computers or when sheet music is being copied. In such cases, a particular set of instructions (e.g., a succession of 0 and 1 or musical notation) that produces a particular effect – the 'phenotype' as a computer application or a musical performance – can be transmitted without it serving as a template for the 'genotype.' However, we will not discuss these cases here since they are very recent (culturally evolved) forms of cultural transmission.

10 We say *quasi*-universal because some prokaryotic organisms, some cellular organelles, and even some eukaryotic organisms (e.g., the yeast *Candida*) use a slightly different code from the rest of life (Watson et al. 2013, 587–90).

Further, although most events of cultural transmission rely in some way on some psychological mechanisms, these mechanisms are most likely very different for the transmission of different cultural items (Charbonneau et al. 2022). Indeed, there is little similarity in the cognitive mechanisms involved between building a house, maintaining a fire, tracking prey, abiding by social norms, recalling a story, solving a linear equation, and speaking some language. Moreover, there are very different cognitive processes and learning regimes involved in acquiring these skills from others. Transmitting knowledge about how to do something (e.g., techniques) typically involves action recognition, coordination mechanisms, and haptic reasoning in the learner, in addition to action planning, motor control, and online corrections when producing the technique (ibid.). Transmitting knowledge through language depends on audition and speech recognition for the learner, pronunciation and syntax for the producer, and the several mechanisms involved in pragmatics and semantics for both. And so forth. Thus, it is implausible that a single set of rules – as in the case of DNA replication – can be used to determine the grain of description at which any and all episodes of cultural transmission ought to be described. Indeed, DNA transmission relies on a mechanism specifically replicating nucleotide sequences, whereas the cognitive processes involved in transmitting cultural items vary with the nature and content of those items (Claidière and André 2012). In other words, the mechanisms involved in cultural transmission are likely to be content-dependent and vary between whether a public display is produced or a mental representation is formed; thus, they do not share a universal rule for transmission as DNA replication does.

To complicate the problem, the transmission of a single cultural item often relies on multiple different cognitive mechanisms, each of which serves to transmit some features of the cultural item but not others. Consider the telephone game again. Phonological mechanisms (e.g., 'I can or cannot hear the pitch difference'), pronunciation mechanisms (e.g., 'I succeed or fail to produce it'), and semantic understanding (e.g., 'does it mean "mother" or "horse"?') are all involved in the transmission of the message. Yet, they relate to different features of the item. Any inter-individual variation in any of these mechanisms threatens the discovery of a universal mode of transmission in the cultural domain.

Is there a specific rule dictating which aspects of any and all cultural items we should focus on in an event of cultural transmission? We doubt it. Contrary to what we find in the biological domain, the fidelity of transmission of cultural items must *always* be assessed within a specific context to set a relevant grain of description (Charbonneau and Bourrat 2021). Without this crucial step, asking about the degree of fidelity of cultural transmission of a cultural item would be akin to asking whether the message in our telephone game example is transmitted faithfully without knowing the specific rules of the language used in that specific context. Depending on which feature one focuses on, the same item might be considered faithfully transmitted or not. For instance, in the telephone game example, the succession of the phonemes /m/ and /a/ is transmitted faithfully through the lineage, but neither is the toneme (the specific tone for 'ma') nor the semantics. With no specified context to guide the choice of a grain of description, any claim about the fidelity of transmission in the cultural domain is incomplete.

To highlight more vividly the disanalogy between cultural and genetic modes of transmission, consider the following: were the latter like the former, genetics would be a science where the only traits geneticists are interested in are those carried by DNA itself (e.g., DNA_{NB} and DNA_{CI}). Without any constraint on some particular features of the molecule to study, there would be an infinity of them for which to assess the fidelity of transmission between two generations, with DNA_{NB} and DNA_{CI} being only two of them.

3.2 *Fidelity of Transmission in Cultural Evolution*

The conclusion reached in the previous subsection is particularly significant in the context of cultural evolution. In the last 30 years, a central debate in the field of cultural evolution has concerned the extent to which cultural transmission serves as a high fidelity transmission mechanism (Boudry 2018; Dawkins 1976; Charbonneau 2020; Dennett 2017; Henrich and Boyd 2002; Laland 2017; Mesoudi 2011; Morin 2016; Aunger 2000; Sperber 2000; Acerbi and Mesoudi 2015; N. Claidière, Scott-Phillips, and Sperber 2014; Charbonneau and Bourrat 2021). Although this debate has often been presented as an empirical one, if our analysis is correct, it should be clear that it could only be so assuming that *all* the protagonists of the debate use the same grain of descriptions in making their claims (see also Charbonneau and Bourrat 2021). Taking the telephone game example again, it would only make sense to debate whether the transmission of the phonemes, the tonemes, or the message meaning is faithful when all the protagonists agree on which feature is relevant. However, it would not be considered empirical when each protagonist focuses on a different feature, and even less so without being explicit about it.

Unfortunately, the different areas of research in cultural evolution often use different grains of description when discussing cultural evolution without being explicit about the chosen grain or recognizing that, without using the same grain of description, the question of whether faithful transmission occurs in culture is underdetermined. For instance, some focus on inspecting the detailed psychological mechanisms underlying communication events

(Scott-Phillips, Blancke, and Heintz 2018; Sperber 2006). Others have explored retracing the transmission of coarsely described cultural practices (e.g., animal husbandry or farming) over long timescales, as in gene–culture coevolutionary modeling (e.g., Aoki 1986; Holden and Mace 1997). Others have studied the morphological evolution of artifacts using the archeological record (e.g., O'Brien, Darwent, and Lyman 2001). These different approaches have produced very different conclusions regarding the fidelity of transmission. Yet, following our analysis, they are not readily comparable because the grain of description used is generally very different. In particular, some of these areas of research use a very fine grain of description, from one individual to the other, much like the telephone game, while others (e.g., memetics and gene–culture coevolution) use a very coarse grain.

In addition to the risk of cultural evolutionists talking past one another, the context dependence of transmission fidelity and the lack of unified mechanisms setting a privileged grain of description in the cultural domain cause an even more troubling problem for the field of cultural evolution. Stated simply, nearly any event of cultural transmission can be shown to represent an event of replication or one of low fidelity merely by changing the resolution at which a description is given.

This problem is most often instantiated in memetics (Dennett 2017; Boudry 2018). When addressing empirical questions about cultural transmission, a scientist has some choice regarding the grain of description at which data will be obtained. However, once a decision is made, this sets the grain at which transmission will be considered, often meaning that, to change the grain, a wholly new dataset must be obtained. However, memetics is predominantly a conceptual account of cultural evolution and does not engage in rigorous empirical research. By being strictly conceptual in finding instances of high or low fidelity transmission, memetics need not commit any of its discussion of cultural transmission at some specific grain of description. Instead, it can arbitrarily and in an *ad hoc* manner select the resolution that will obtain high fidelity transmission. Thus, the memetician can choose the grain(s) of description that fits their preconceived view of fidelity transmission for any event of cultural transmission (Boudry 2018; see also Charbonneau and Bourrat 2021).

To understand how this strategy functions, suppose the chain of transmission in Figure 3. One researcher might claim that the first geometric figure (A) in the chain is not replicated, given that the next geometric figure (B) in the transmission chain is different in some respects. Considering *all* the features of A, this is obviously correct. Further, that it is so should not be surprising. As we discussed above, nothing in the physical realm replicates perfectly, not even DNA, which is nevertheless the paradigmatic example of a replicator (Dawkins 1976; Hull 1980; Blackmore 1999). Now, another researcher, considering only

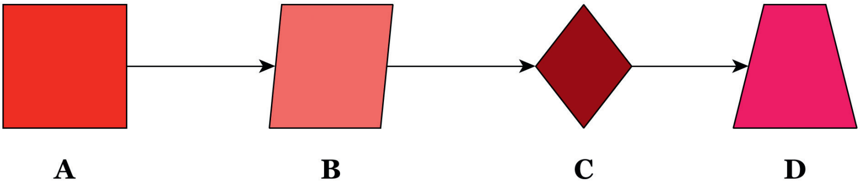

FIGURE 3 A chain of transmission. When a description of the geometric figure is fine-grained (shade or shape), there is no replication between generations. However, when a coarser grain of description is used, replication does occur. The color red and having four sides are features replicated perfectly at each generation.

one feature of A, might reach the same conclusion. There is no replication of the geometric figure's shade, shape, or length of any of its sides. However, another researcher might retort that, if one considers only its color (red) or the number of sides (four), A is replicated perfectly throughout the lineage. By adopting a coarser or less determinate grain of description, it will always be possible to find a grain of description at which cultural items are found to replicate.

To be clear, it is not a problem in itself that a multiplicity of grains of description exists when characterizing the similarity of two or more objects. This is simply a truth about the world. However, this fact can pose further problems, as we have illustrated in two situations. First, issues arise when the protagonists of some debate implicitly use different grains of descriptions. Such a debate might appear empirical; however, this may effectively be because the same thing is not measured in the same way or different protagonists' arguments appear similar but actually refer to different things. Second, it can lead to developing a strategy of changing the grain of description without being explicit (or even conscious) about this to suit what one is interested in demonstrating, namely that cultural items are replicated or not. They might indeed be replicated, but only at some grains of description. However, not being explicit about the resolution at which the degree of fidelity has been assessed might elicit the false idea that they are replicated (or transmitted at some degree of fidelity) *at any grain of description*.

The foregoing remarks might suggest that one way to resolve the grain problem in cultural evolution would be determining an arbitrary convention to set a grain of description by which all researchers will abide. However, this can only be possible in situations where researchers refer to the same features of cultural items but describe their transmission at different resolutions. In many cases, the different grains are not commensurable because they refer to features along different dimensions (Charbonneau 2020). This should deter the argument that there is a single correct approach to cultural transmission.

Nevertheless, that no singular cognitive mechanism would fit all cultural transmission does not mean that one should consider all grains of description as equal. In situations where different resolutions of grains of description are available, consistent with what we have argued above, finer grains of description should be privileged because they also allow recovering coarser grains of description. However, there may be a way to determine whether a grain of description is too fine. Human cognitive capacities are limited in terms of the resolution they can comprehend, such that some grains of descriptions may be too fine for an individual to be able to discern variation at that resolution (e.g., see Eerkens 2000). This suggests a limit beyond which any finer grains of description can be dismissed because a social learner will not capture them. Further, when they refer to features, some grains of descriptions might be (quasi-)universally cognitively irrelevant. Accounting for what is universally cognitively relevant to the human mind could place some key constraints on cultural transmission.

That being said, that cognitive mechanisms ultimately constrain what is culturally transmitted should not cause the outright dismissal of coarse-grained descriptions. Although we consider that the correct approach (if empirically possible) would always be to obtain data about the cognitive mechanisms involved in cultural transmission, we recognize that, often, this data is unavailable. This is particularly the case for large-scale and highly complex cultural phenomena, such as the spread of agriculture (Altman and Mesoudi 2019). Further, coarse-grained descriptions typically provide information about longer timescales than do fine-grained descriptions. For these reasons, in the absence of a limit to fine-grained descriptions, coarser-grained descriptions for events of cultural transmission can generate essential insights that could not be obtained otherwise. Nevertheless, it would be erroneous to compare the fidelity of transmission obtained from coarse-grained descriptions to those obtained from finer-grained descriptions or to use coarse-grain descriptions when finer-grained descriptions are available.

4 Conclusion

In this paper, we presented the 'grain problem' in events of transmission of information. We showed that, in biology, this problem can be circumvented due to the existence of genotype–phenotype mapping. Beginning with the reasoning that, contrary to the biological domain, there is no useful distinction to draw between genotype and phenotype in the cultural domain, we identified a crucial requirement for disagreements about the fidelity of transmission in the cultural domain to be meaningful. This requirement, we have argued, is that the grain of description used by the different researchers involved is the same. There is a lack of unity in the fields studying cultural evolution and the mechanism(s) involved in cultural transmission, leading different research traditions to use, often implicitly, different grains of description; therefore, it is a matter of urgency that the problem is recognized as such. Only when this problem is recognized to its full extent can cultural evolutionists start building conventions to study the fidelity of cultural transmission more rigorously (Charbonneau 2020; Charbonneau and Bourrat 2021).

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